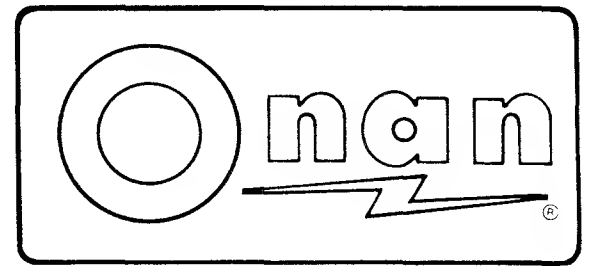


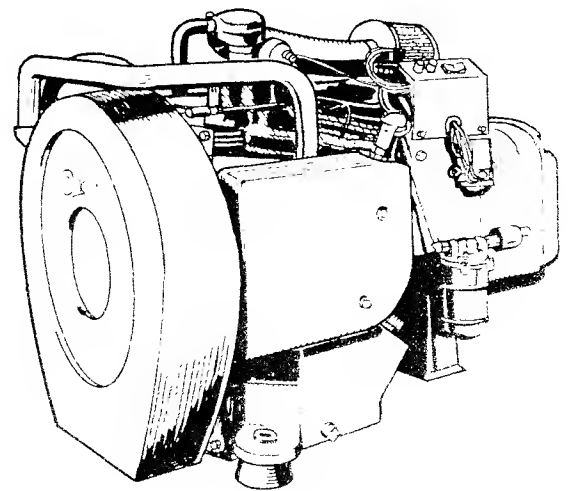
operator's manual



For series

BF

**R.V. Electric
Generating Sets**



SAFETY PRECAUTIONS

The following symbols in this manual signal potentially dangerous conditions to the operator or equipment. Read this manual carefully. Know when these conditions can exist. Then, take necessary steps to protect personnel as well as equipment.

WARNING Onan uses this symbol throughout this manual to warn of possible serious personal injury.

CAUTION This symbol refers to possible equipment damage.

Fuels, electrical equipment, batteries, exhaust gases and moving parts present potential hazards that could result in serious, personal injury. Take care in following these recommended procedures.

- **Use Extreme Caution Near Gasoline. A constant potential explosive or fire hazard exists.**

Do not fill fuel tank near unit with engine running. Do not smoke or use open flame near the unit or the fuel tank.

Be sure all fuel supplies have a positive shutoff valve.

Fuel lines must be of steel piping, adequately secured and free of leaks. Use a flexible section of fuel line between generator set and stationary fuel line in the vehicle. This flexible section must be 100% NON-METALLIC to prevent electrical current from using it as a conductor.

Have a fire extinguisher nearby. Be sure extinguisher is properly maintained and be familiar with its proper use. Extinguishers rated ABC by the NFPA are appropriate for all applications. Consult the local fire department for the correct type of extinguisher for various applications.

- **Guard Against Electric Shock**

Remove electric power before removing protective shields or touching electrical equipment. Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when around electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on electrical equipment.

Always use an appropriately sized, approved double-throw transfer switch with any standby generator set. **DO NOT PLUG PORTABLE OR STANDBY SETS DIRECTLY INTO A HOUSE RECEPTACLE TO PROVIDE EMERGENCY POWER.** It is possible for current to flow from generator into the utility line. This creates extreme hazards to anyone working on lines to restore power.

Use extreme caution when working on electrical components. High voltages cause injury or death.

Follow all state and local electrical codes. Have all electrical installations performed by a qualified licensed electrician.

- **Do Not Smoke While Servicing Batteries**

Lead acid batteries emit a highly explosive hydrogen gas that can be ignited by electrical arcing or by smoking.

- **Exhaust Gases Are Toxic**

Provide an adequate exhaust system to properly expel discharged gases. Check exhaust system regularly for leaks. Ensure that exhaust manifolds are secure and not warped.

Be sure the unit is well ventilated.

- **Keep The Unit And Surrounding Area Clean**

Remove all oil deposits. Remove all unnecessary grease and oil from the unit. Accumulated grease and oil can cause overheating and subsequent engine damage and may present a potential fire hazard.

Do NOT store anything in the generator compartment such as oil cans, oily rags, chains, wooden blocks etc. A fire could result or the generator set operation may be adversely affected. Keep the floor clean and dry.

- **Protect Against Moving Parts**

Avoid moving parts of the unit. Loose jackets, shirts or sleeves should not be permitted because of the danger of becoming caught in moving parts.

Make sure all nuts and bolts are secure. Keep power shields and guards in position.

If adjustments *must* be made while the unit is running, use extreme caution around hot manifolds, moving parts, etc.

Do not work on this equipment when mentally or physically fatigued.

TO THE OWNER

Welcome to the growing family of *Onan Power users* . . . We are proud to have you as a customer.

Read this manual carefully and observe all safety rules within. Operating instructions, adjustments and periodic maintenance procedures are given so that you . . . the owner, can keep your unit running like new and expect many years of dependable service from it. Remember . . . any machine, regardless of design or type, will perform only in relation to the services it receives.

If your generator set needs special attention, ask your Onan dealer for assistance; the Onan Parts and Service Organization has been factory-trained to provide up-to-date know-how for keeping your RV electric generating set "on the road". A complete Parts Catalog is available at nominal cost and may be ordered under #965-0220.

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WARNING

TO PREVENT FIRE OR ACCIDENT HAZARD . . .
THIS UNIT MUST BE INSTALLED ACCORDING
TO THE MANUFACTURER'S DETAILED IN-
STALLATION PROCEDURES OBSERVING ALL
MINIMUM CLEARANCES.

TO AVOID POSSIBLE PERSONAL INJURY OR
EQUIPMENT DAMAGE, ANY INSTALLATION
AND ALL SERVICE MUST BE PERFORMED BY
QUALIFIED PERSONNEL.

GENERAL INFORMATION

YOUR MANUAL

This manual contains operation and other information to properly maintain, service, and make adjustments on your BF generator set. Study and follow the instructions carefully. A well-planned service and maintenance program will result in longer unit life and better performance. Because the most important part of repair is diagnosis, a troubleshooting chart is included.

Throughout the manual, engine end of the generator set is the front. Left and right sides are determined when facing the engine (front) end.

When contacting your Onan dealer, distributor, or the factory about the generator set, always supply the complete model number and serial number as shown on the nameplate (see *Model Designation* following). This information is necessary to identify your generator set among the many types manufactured by Onan.

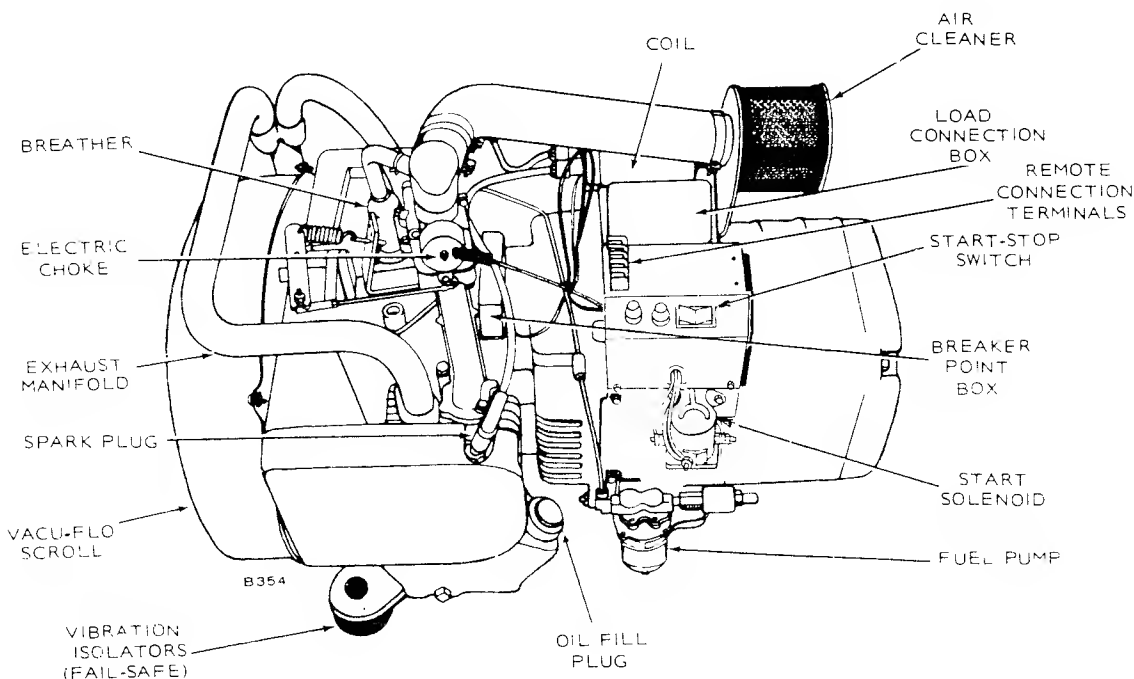
MODEL DESIGNATION

The following typical model number is broken down into code segments used by Onan.

4.0	BF	-	3C	R	16000	B
1	2		3	4	5	6

1. Indicates kilowatt rating.
2. Series identification.
3. Number 3 is the voltage code for 120/240 volts single phase. "C" is the code for reconnectable (120 volts, 2 wire; and 120/240 volts, 3 wire).
4. Method of starting: R-remote electric starting.
5. Factory code for designating optional equipment if any.
6. Specification letter which advances when the factory makes production modification.

Onan electric sets are given a complete running test under various load conditions and are thoroughly checked before leaving the factory. Upon receiving your unit, check it thoroughly for any damage that may have occurred during shipping. Tighten loose parts, replace missing parts and repair any damage before operating the unit.



SPECIFICATIONS

This manual contains SI metric equivalents that follow immediately in parentheses after the U.S. customary units of measure.

GENERAL

Nominal Dimensions of Set

Height	20-3/8 in. (542.93 mm)
Width	17.50 in. (444 mm)
Length	28-3/8 in. (720.73 mm)*
Weight	217 lbs. (98.43 kg)

ENGINE DETAILS

Manufacturer	Onan
Number of Cylinders	Two
Displacement (cubic inches)	40.25 (660.1 cm ³)
Cylinder Bore	3-1/8 in. (79.38 mm)
Piston Stroke	2-5/8 in. (66.68 mm)
Compression Ratio	7.0:1
Engine Speed	1800 RPM
Engine Design	Four Cycle, Air Cooled, L-Head Horizontally Opposed
Starting System	Exciter Cranking (Generator)

GENERATOR DETAILS

Manufacturer	Onan
Design	Revolving Armature, Four Pole, 1800 RPM
Rating (in Watts)	4000 Watts (4 kW)
Voltage	120 or 120/240
Current Rating	
120 Volt	33.3 amperes
240 Volt	16.6 amperes
Phase	Single
Wire	4 Wire Reconnectable
Output Rating	Unity Power Factor
Cranking Current	75 amps

CAPACITIES AND REQUIREMENTS

Oil Capacity	4 qts. (3.79 litres)
Recommended Battery	
Electric Start	12 Volt 74 Amp/Hr (266.40 kC)
Battery Charge Rate	
Fixed	1 - 1½ amps
Optional (2-step)	1½ - 5 amps
Ventilation Requirements (Total)	80 sq. in. (516 cm ²)

TUNE-UP SPECIFICATIONS

Spark Plug Gap025 in. (0.64 mm)
Breaker Point Gap (cold setting)021 in. (0.53 mm)
Ignition Timing Reference (cold setting)	21° BTC
Valve Tappet Adjustment (engine cold)	
Intake003 in. (0.08 mm)
Exhaust010 in. (0.25 mm)

* Add two inches for UL listed model.

INSTALLATION CHECKS

INSTALLATION

Nearly all Onan electric generating sets are installed by the motor home manufacturer. Although the manufacturer must follow safety codes when installing, certain installation problems could arise after the unit is installed and subjected to vibration. There are a few areas that you as the operator should be concerned with. If in doubt about any aspect of your generator set's operation or safety, contact your nearest authorized Onan Service Center. A daily inspection of your installation should include the following:

EXHAUST

Check for leaks around manifolds, gaskets, and welds. Make sure exhaust lines are not heating surrounding areas excessively. If so, have corrected immediately. Remember EXHAUST GASES CONTAIN DEADLY CARBON MONOXIDE. Be sure all holes to the inside of RV from set compartment are sealed to prevent poisonous exhaust gases from entering vehicles.

WARNING All exhaust shielding supplied with unit MUST be properly installed to prevent overheating of compartment walls or the possibility of fire.

FUEL SYSTEM

With set running, check for leaks. Raw fuel will cause fumes which could EXPLODE. Check around carburetor and fuel pump inlets. Make sure fuel lines are not rubbing against anything which could cause breakage.

ELECTRICAL

AC Output: All AC leads (M1, M2, M3 and M4) terminate in generator sets junction box. These wires should be connected to distribution box with multistrand wire enclosed in a flexible conduit. Check all wires (to and from the generator set) for fraying and loose connections. For information on load connections refer to operation section following.

Battery Connections: Battery positive (+) connection connects to start solenoid. Battery negative connects to location on rear of generator. Check terminals on set and battery for clean and tight connections.

WARNING Separate installation area or compartment from living quarters by a vapor-tight wall to prevent entrance of noxious fumes to interior.

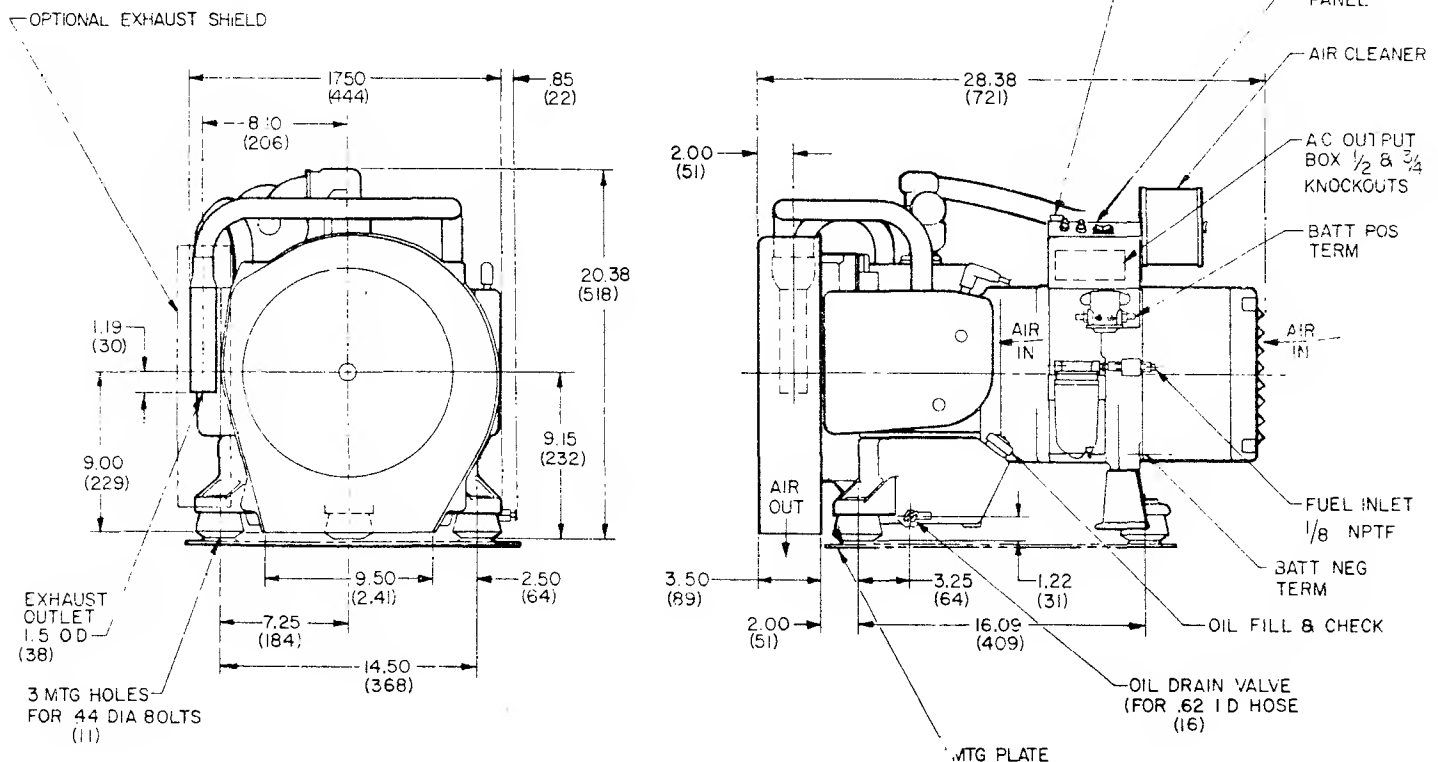


FIGURE 1. INSTALLATION OUTLINE

WARNING

Do NOT use maintenance free, unvented batteries with this generator set. Malfunction of the starting-charging system can produce high charging currents, causing excessive gassing. An unvented battery can build up sufficient pressure to explode.

Grounding: Generator must be effectively bonded to recreational vehicle chassis.

For additional information on installation contact your Onan Service Representative or request Technical Bulletin (T-012) from Onan.

Vehicle chassis (frame) ground and the battery and generator set ground should all be electrically connected to be at 0 ground potential. All Onan units are designed for negative ground application.

WARNING

Mount the battery in a separate compartment from the set or any spark-producing device to prevent fire or explosion.

VENTILATION

The biggest enemy of electric generating sets installed in motor homes is excessive heat. Make sure the set's air inlet and outlet are not plugged with dust, dirt, bugs, leaves or anything that could restrict cooling air.

WARNING

Don't use discharged cooling air for compartment heating since it could contain poisonous exhaust gases.

WARNING

Do not terminate exhaust under vehicle, as carbon monoxide gas is poisonous. Direct exhaust gases away from window and door openings.

WARNING

On all listed models with exhaust shielding supplied with unit, shielding **MUST** be properly installed to prevent overheating of compartment walls or the possibility of fire. Refer to appropriate installation guide for each model for details.

WARNING

DO NOT DISCONNECT BATTERY CABLES FROM BATTERY WHILE GENERATOR SET IS CRANKING OR RUNNING; SPARKS MAY CAUSE AN EXPLOSION.

IMPORTANT: Certain states (particularly California) have state ordinances pertaining to the type and usage of exhaust muffler/spark arresters on internal combustion engines or engine driven equipment when used in a recreational vehicle such as electric generating sets. Be sure your installation meets all Federal, State and local codes pertaining to your unit. Failure to provide and maintain a spark arrester may be in violation of the law.

WARNING**ENGINE EXHAUST GAS (CARBON MONOXIDE) IS DEADLY!**

Carbon monoxide is an odorless, colorless gas formed by incomplete combustion of hydrocarbon fuels. Carbon monoxide is a dangerous gas that can cause unconsciousness and is potentially lethal. Some of the symptoms or signs of carbon monoxide inhalation are:

- Dizziness
- Intense Headache
- Weakness and Sleepiness
- Vomiting
- Muscular Twitching
- Throbbing in Temples

If you experience any of the above symptoms, get out into fresh air immediately.

The best protection against carbon monoxide inhalation is a regular inspection of the complete exhaust system. If you notice a change in the sound or appearance of exhaust system, shut the unit down immediately and have it inspected and repaired at once by a competent mechanic.

OPERATION

BEFORE STARTING

CRANKCASE OIL

Oil capacity of the BF generator set is 4 U.S. quarts (3.79 lit). Fill the crankcase until the oil reaches the "FULL" mark on the oil level indicator (Figure 2). DO NOT OVERFILL.

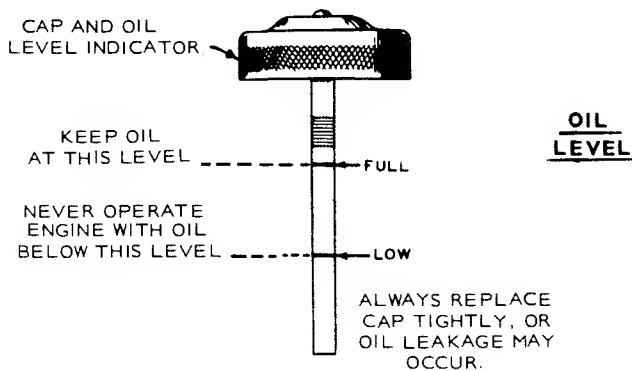


FIGURE 2. CHECKING OIL LEVEL

Use a good quality, heavy duty oil with the API (American Petroleum Institute) designation SE or SE/CC (gasoline operation only). If this oil is not available, SD or SD/CC designated oil can be used.

Check oil level daily and change oil every 100 normal operating hours. See Figure 3 for location of oil drain. If operating in extremely dusty or dirty conditions, the oil might have to be changed sooner. When adding oil between changes, use the same brand as in the crankcase. Various brands of oil might not be compatible when mixed.

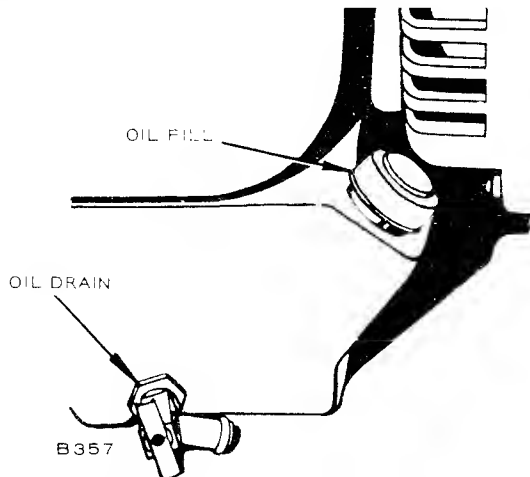


FIGURE 3. OIL DRAIN AND FILL

WARNING

Do NOT check oil while the generator set is operating. Hot oil could cause burns by blowing out of oil fill tube due to crankcase pressure.

TEMPERATURE	GRADE
Below 0° F (-18° C)	5W or 5W-30
0° to 32° F (-18° C to 0° C)	10W or 10W-40
Above 32° F (0° C)	30

Oil consumption may be higher with a multigrade oil than with a single-grade oil if both oils have comparable viscosities at 210° F (99° C). Therefore, single grade oils are generally more desirable unless anticipating a wide range of temperatures. Use the proper grade oil for the expected conditions.

Use of the same grade and quality oil as that used in your recreational vehicle engine is acceptable as long as unit is serviced regularly and oil meets API designation SE or SE/CC. Other factors (primarily temperature) should also be considered when selecting appropriate engine oil.

RECOMMENDED FUEL

All Onan AC electric generating sets for recreational vehicles use gasoline fuel. Because any AC electric generating set runs at a constant speed, lead deposits tend to build up in the combustion chambers. For this reason, use clean, fresh, lead free or low-lead gasoline. Regular grade gasoline may also be used, but DO NOT use highly leaded premium types of fuel.

For new engines, the most satisfactory results are obtained by using nonleaded gasoline. For older engines that have previously used leaded gasoline, the cylinder heads must be taken off and all lead deposits removed from engine before switching to nonleaded gasoline.

CAUTION

Lead deposits must be removed from an engine before switching from leaded to nonleaded gasoline. If not, preignition can occur causing engine damage.

WARNING

Leakage of gasoline in or around the compartment is a definite hazard. The ventilation system should provide a constant flow of air to expel any accumulation of fuel vapor while the vehicle is in transit. Compartments must be vapor tight to the interior to keep fumes from within the vehicle.

STARTING

Push the start-stop switch to the start position. Release the switch when engine starts. If engine fails to start, inhibitor oil used at the factory may have fouled the spark plugs. Remove the plugs, clean in a suitable solvent, dry thoroughly and re-install. Heavy exhaust smoke when the engine is first started is normal and caused by the inhibitor oil.

STOPPING

Push the start-stop switch to the stop position and hold until unit stops completely.

BREAK-IN PROCEDURE

Controlled break-in with the proper oil and a conscientiously applied maintenance program will help to assure satisfactory service from your Onan electric generating set. Break-in as follows:

1. One half hour at 1/2 load (with one air conditioner) only.
2. One half hour at 3/4 load (with one air conditioner) and approximately 1000 watts additional load.
3. Change crankcase oil after the first 50 hours of operation.

APPLYING LOAD

If practical, allow set to warm up before connecting a heavy load. Continuous generator overloading may cause high operating temperatures that can damage the windings. Keep the load within nameplate rating.

RECONNECTIBLE, SINGLE-PHASE GENERATOR

Voltage selection on reconnectible single-phase generators is for use as 120/240 volts, 3 wire; or 120 volts, 2 wire. Use the connection for two-wire service when one load exceeds one half the rated capacity. Balance the load when connecting for three wire service. Current for any one output lead must not exceed nameplate rating. When two or more single-phase circuits are available, divide the load equally between them. See Figure 4.

LOAD CONNECTIONS

1. Generator set load wires M1, M2, M3 and M4 terminate within the junction box. Connect and join wires within junction box in an approved manner for desired voltage code. See Figure 4.
2. Wires must be adequate size, properly insulated and supported.
3. Mount switches and controls securely to prevent damage from vibration and road shocks. All switches must be vibration proof to prevent accidental opening or closing while the vehicle is in motion.
4. All wiring must meet applicable local electrical codes. Have a qualified electrician install and inspect the wiring.

EXERCISE

Infrequent use results in hard starting. Operate the generator set one 30-minute period each week. Run longer if battery needs charging. Exercising for one long period each week is better than several short periods.

BATTERY CHARGING

The battery charge rate is controlled by a fixed value resistor that allows a trickle charge rate of 1 - 1-1/2 amps under all conditions. An optional 2-step variable rate system is available at extra cost.

HIGH OPERATING TEMPERATURE CONDITIONS

1. See that nothing obstructs air flow to and from the set.
2. Keep cooling fins clean. Air housing should be properly installed and undamaged.
3. Keep ignition timing properly adjusted.

LOW OPERATING TEMPERATURE CONDITIONS

1. Use correct SAE oil for temperature conditions. Change oil only when engine is warm. If an unexpected temperature drop causes an emergency, move vehicle to a warm location.
2. Use fresh gasoline. Protect against moisture condensation. Below 0°F (-18°C), adjust carburetor main jet for a slightly richer fuel mixture.
3. Keep ignition system clean, properly adjusted and batteries in a well charged condition.
4. Partially restrict cool airflow, but use care to avoid overheating.

EXTREMELY DUSTY AND DIRTY CONDITIONS

1. Keep unit clean. Keep cooling surfaces clean.
2. Service air cleaner as frequently as necessary.
3. Change crankcase oil every 50 operating hours.
4. Keep oil and gasoline in dust-tight containers.
5. Keep governor linkage clean.
6. Clean generator brushes, slip rings, and commutator. *do not* remove normal dark brown film. *Do not* polish.

HIGH ALTITUDE OPERATION

For operation at altitudes of 2500 feet (775 m) above sea level, close carburetor main jet adjustment slightly to maintain proper air-to-fuel ratio (refer to the *ADJUSTMENTS* section). Maximum power will be reduced approximately four percent for each 1000 feet (310 m) above sea level after the first 1000 feet.

POWER REQUIREMENTS FOR APPLIANCES

Appliance or Tool	Approximate Running Wattage
Refrigerator	600-1000
Electric broom	200-500
Coffee percolator.....	550-700
Electric frying pan	1000-1350
Hair dryer	350-500
Electric stove (per element)	350-1000
Electric iron	500-1200
Radio	50-200
Electric water heater.....	1000-1500
Space heater	1000-1500
Electric blanket.....	50-200
Television	200-600
Electric drill	250-750
Battery charger.....	Up to 800
Electric water pump	500-600
Air Conditioner.....	1400-2000
Converter	300-350

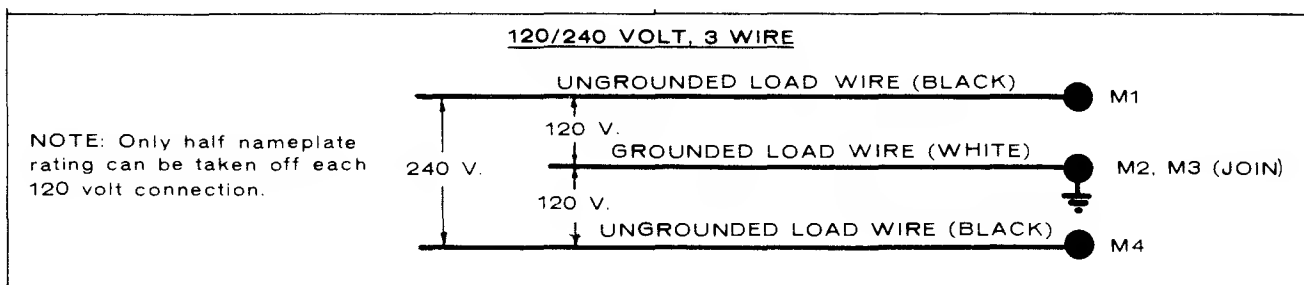
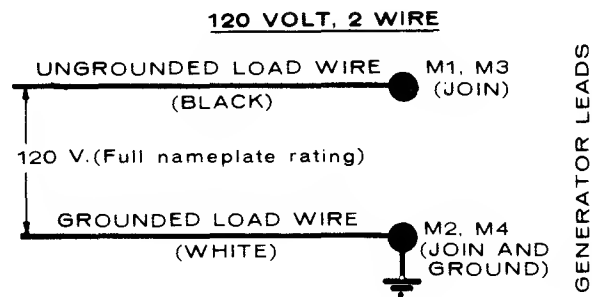


FIGURE 4. SINGLE-PHASE, "3C" VOLTAGE CODE GENERATOR CONNECTIONS

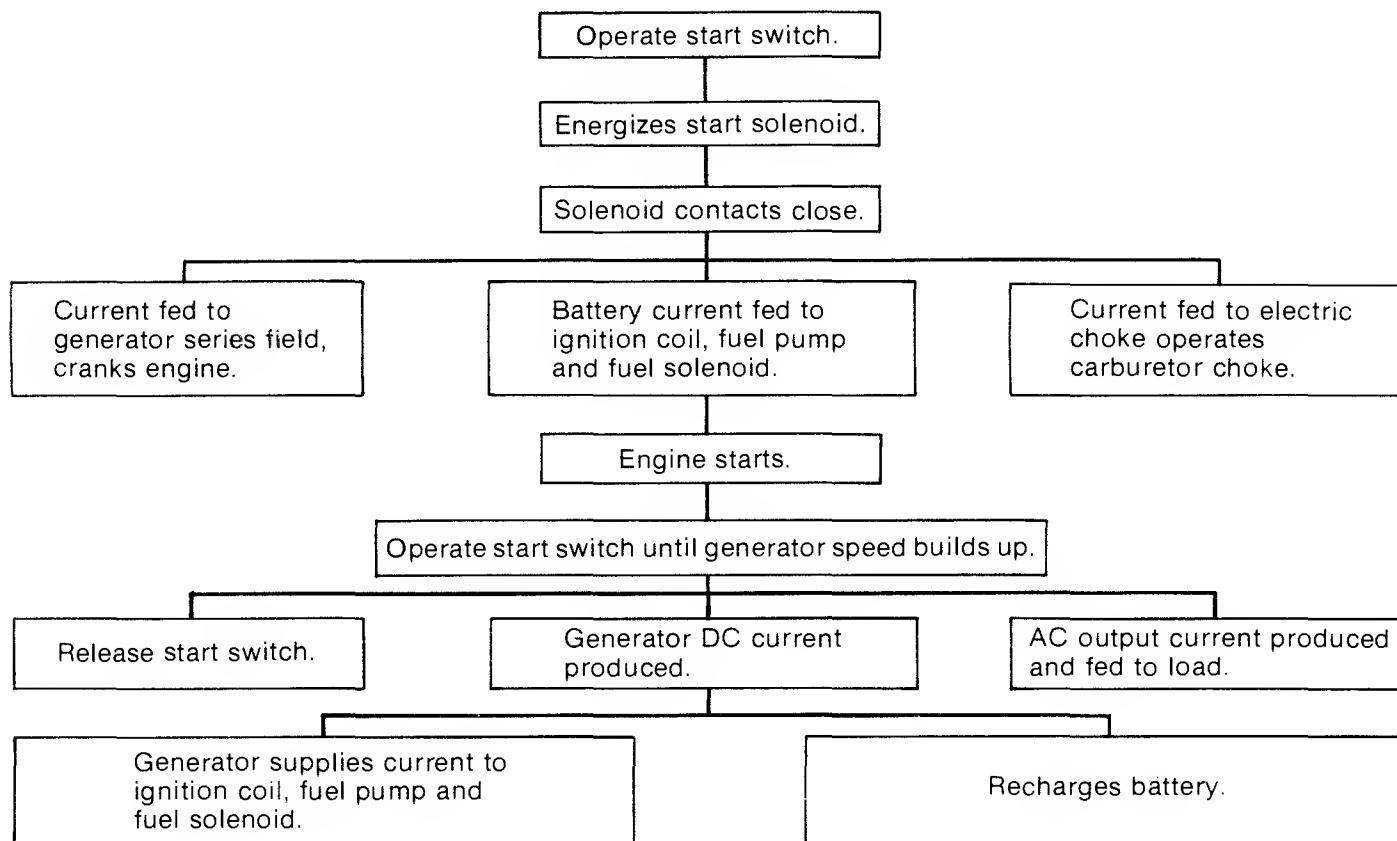


FIGURE 5. SEQUENCE OF OPERATION

SEQUENCE OF OPERATION

Figure 5 shows the operation sequence of the BF electric generating set.

ENGINE TROUBLESHOOTING

TROUBLE																					GASOLINE ENGINE TROUBLESHOOTING GUIDE		CAUSE
Backfire at Carburetor	Bearing Wear	Black Exhaust	Blue Exhaust	Burned Valves	Connecting Rod Wear	Crankshaft Slowly	Cylinder Wear	Engine Stops	Failure to Start	Governor Hunting	High Oil Pressure	Loose Oil Pressure	Loss of Coolant (Water Cooled)	Mechanical Knocks	Misfiring	Overheating (Air Cooled)	Overheating (Water Cooled)	Piston Wear	Poor Compression	Ring Wear	Sticking Valves		
																					STARTING SYSTEM		
																					Loose or Corroded Battery Connection		
																					Low or Discharged Battery		
																					Faulty Starter		
																					Faulty Start Solenoid		
																					IGNITION SYSTEM		
																					Ignition Timing Wrong		
																					Wrong Spark Plug Gap		
																					Worn Points or Improper Gap Setting		
																					Bad Ignition Coil or Condenser		
																					Faulty Spark Plug Wires		
																					FUEL SYSTEM		
																					Out of Fuel - Check		
																					Lean Fuel Mixture - Readjust		
																					Rich Fuel Mixture or Choke Stuck		
																					Engine Flooded		
																					Poor Quality Fuel		
																					Dirty Carburetor		
																					Dirty Air Cleaner		
																					Dirty Fuel Filter		
																					Defective Fuel Pump		
																					INTERNAL ENGINE		
																					Wrong Valve Clearance		
																					Broken Valve Spring		
																					Valve or Valve Seat Leaking		
																					Piston Rings Worn or Broken		
																					Wrong Bearing Clearance		
																					COOLING SYSTEM (AIR COOLED)		
																					Poor Air Circulation		
																					Dirty or Oily Cooling Fins		
																					Blown Head Gasket		
																					COOLING SYSTEM (WATER COOLED)		
																					Insufficient Coolant		
																					Faulty Thermostat		
																					Worn Water Pump or Pump Seal		
																					Water Passages Restricted		
																					Defective Gaskets		
																					Blown Head Gasket		
																					LUBRICATION SYSTEM		
																					Defective Oil Gauge		
																					Replenish Valve Stuck		
																					Faulty Oil Pump		
																					Dirty Oil or Filter		
																					Oil Too Light or Diluted		
																					Oil Level Low		
																					Oil Too Heavy		
																					Dirty Crankcase Breathe Valve		
																					THROTTLE AND GOVERNOR		
																					Linkage Out of Adjustment		
																					Linkage Worn or Disconnected		
																					Governor Spring Sensitivity Too Long		
																					Linkage Binding		

MAINTENANCE

BATTERY CARE

To increase battery life, the operator can perform a number of routine checks and some preventive maintenance.

1. Keep the battery case clean and dry.
2. Make sure the battery cable connections are clean and tight. Use a terminal puller when removing cables for any reason.
3. Coat the battery terminals with a mineral grease or petroleum jelly to reduce corrosion and oxidation.
4. Identify each battery cable to be positive or negative before making any connection. Always connect the ground (negative) cable last.
5. Maintain the electrolyte level by adding water (drinking quality or better) as needed for filling to split level marker. (The water ingredient of the electrolyte evaporates, but the sulphuric acid ingredient remains. Therefore, add water, not electrolyte.
6. Avoid overcharging when recharging. Stop the boost charge when the specific gravity is 1.260 and the electrolyte is 80° F (26.7° C).

FUEL SOLENOID

Evaporative control systems on late model motor homes require a positive fuel shutoff valve to prevent the generator set from flooding when not in use. It connects to the fuel pump terminal.

Onan Electric Fuel Pump

Every 100 operating hours or sooner, clean the filters. To gain access to the filters in the Onan fuel pump (Figure 6), remove the four top Phillips head screws and lift off the top filter assembly. Clean the two screen filters, reinstall and remount the top filter assembly. Be sure the gasket is in place.

COOLING SYSTEM

The generator set is cooled by a flywheel blower fan which pulls air over the cylinders and cooling fins. The air path is directed by sheet metal shrouds and plates. These shrouds and plates must always be installed properly so unit does not overheat.

Check and clean (if necessary) the cooling fins at least every 200 hours of operation. Remove any dust, dirt or oil which may have accumulated. Check compartment air inlet and generator set air outlet for buildup of dirt, chaff, etc.

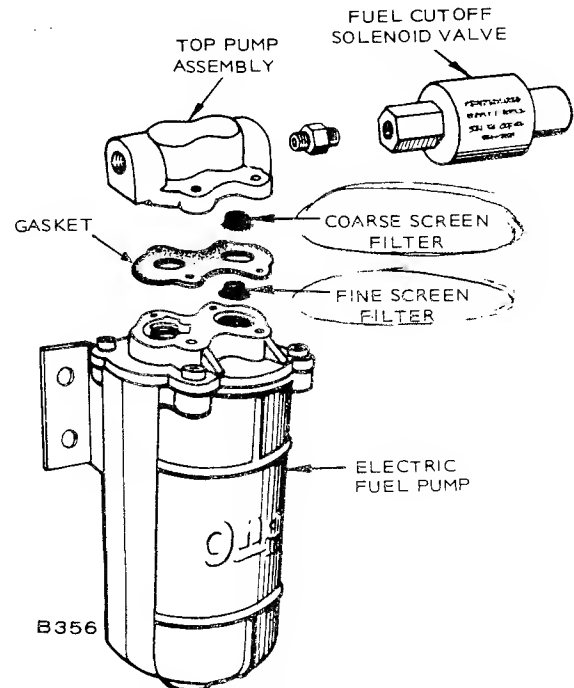


FIGURE 6. ONAN FUEL PUMP

AIR CLEANER ELEMENT

Check and clean element at least every 100 hours. Loosen wing nut to remove. Clean by tapping base lightly on a flat surface. Replace element at least every 200 operating hours; clean or replace more often in dusty conditions. See Figure 7.

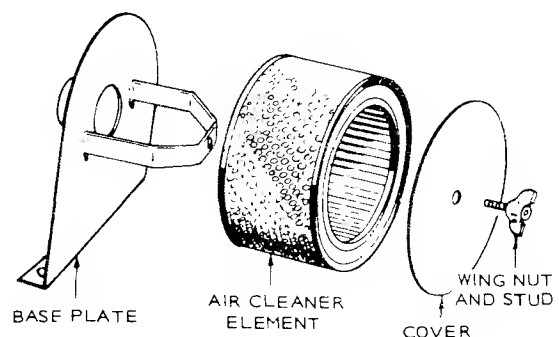


FIGURE 7. AIR CLEANER ELEMENT

SPARK PLUGS

Replace spark plugs every 100 hours or at least once a year. A badly leaded plug will cause misfiring, poor operation or stopping when a load is applied.

- Black deposits indicate a rich mixture.
- Wet plug indicates misfiring.
- Badly or frequently fouled plug indicates the need for a major tune-up.

Each time the spark plugs are removed, inspect, clean and regap (Figure 8). If the plug looks discolored or has fouled, replace it.

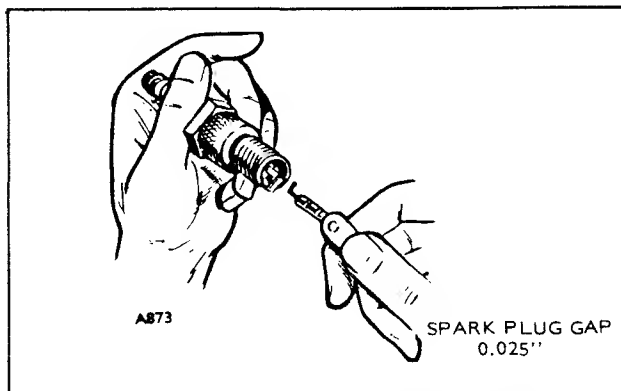


FIGURE 8. CHECKING SPARK PLUG GAP

GOVERNOR LINKAGE

The linkage must be able to move freely through its entire travel. Every 50 hours of operation, clean the joints and lubricate as shown in Figure 9. Also inspect the linkage for binding, excessive slack and wear.

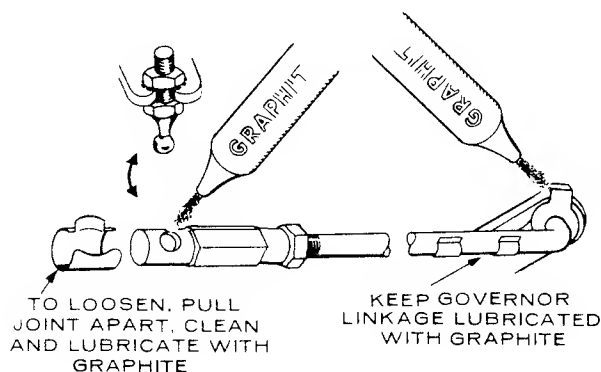


FIGURE 9. GOVERNOR LINKAGE

OUT-OF-SERVICE PROTECTION

Protect a generator set that will be out of service for more than 30 days from damage caused by rust or corrosion. Use the following procedure to properly protect the set.

1. Run the generator set with at least a 50% load until thoroughly warm (usually about 1 hour).
2. Turn off fuel supply and allow the engine to run out of fuel. Also operate the choke manually as

the engine stops to help drain the carburetor completely.

3. Drain the oil from oil base while engine is still warm. Replace the oil filter if so equipped. Replace drain plug and refill. Attach a warning tag stating type and viscosity of oil used.
4. Remove spark plugs. Pour 1 ounce of rust inhibitor oil (or SAE #10) into each cylinder. (Spray cans work well for this application). Turn engine over by hand at least 2 complete revolutions. Replace the spark plugs.
5. Replace the air cleaner at least on an annual basis.
6. Plug the exhaust outlet to prevent entrance of moisture, dirt, bugs, etc.
7. Clean and oil all exposed engine parts including carburetor and governor linkage.
8. Wipe generator brushes, slip rings, housing, etc. Do not apply any lubricant or preservative.
9. Remove the battery and store in a cool dry place. Coat the battery terminals and cable connections with vasoline or grease to prevent any corrosion. Recharge the battery at least monthly or maintain with a trickle type battery charger.
10. Provide a suitable cover if the unit is exposed to the elements.

RETURNING THE UNIT TO SERVICE

1. Remove the cover and all protective wrapping. Wipe the oil film off all exposed engine parts. Remove the plug from the exhaust outlet.
2. Visually inspect the unit for any damage. Check to be sure the carburetor and governor linkage are free. Remove the generator end bell band and check to be sure the brushes work freely in their holders.
3. Check the tag to ensure oil of the proper brand and grade has been installed. Check the oil level.
4. Install the battery (be sure battery is fully charged), observing proper polarity. Ground is negative.
5. Remove spark plugs, clean and gap. Turn the engine over by hand several times. Reinstall spark plugs.
6. Turn on fuel, disconnect electric fuel pump lead and electric fuel solenoid shut-off lead if unit is so equipped. Jumper the fuel pump and electric fuel solenoid shut-off leads to the battery to prime the unit. Use the hand primer lever on units with mechanical pumps. Reconnect the leads.
7. Remove all load and start the generator set at the unit. Initial start may be slow due to oil or rust inhibitor in the cylinders. Excessive smoke and rough operation will occur until the oil or rust inhibitor is burned off.
8. Apply a 50% load after the set runs smooth. Allow the generator set to warm up (1 hour) with the load connected. Check speed and voltage.
9. Unit is now ready for service.

GENERATOR MAINTENANCE

The generator normally needs little care other than a periodic check of the brushes, commutator and collector rings. If a major repair job on the generator should become necessary, have the equipment checked by a competent electrician who is thoroughly familiar with the operation of electric generator equipment.

Brush Replacement

Install new brushes when the old ones are worn to the dimensions shown in Figure 10. Remove the end bell band to expose the brush holders. Remove the three screws holding each brush holder in place (Figure 10). Remove the old brushes and clean the holders so the new brushes can move easily in their holders. Install the new brushes in the same manner as the old ones. Always use the correct brush as listed in the *PARTS INFORMATION SECTION*. Never substitute a brush which may appear to be the same for it may have different characteristics. New brushes are shaped to fit and seldom need sanding to seat properly. If some brush sparking occurs after replacing brushes, run the set under a light load until the brushes wear to a good seat.

Collector rings acquire a glossy brown finish in normal operation. Do not attempt to maintain a bright newly machined appearing surface. Ordinary cleaning with a dry, lint free cloth is usually sufficient. Very fine sandpaper (#00) may be used to remove slight roughness.

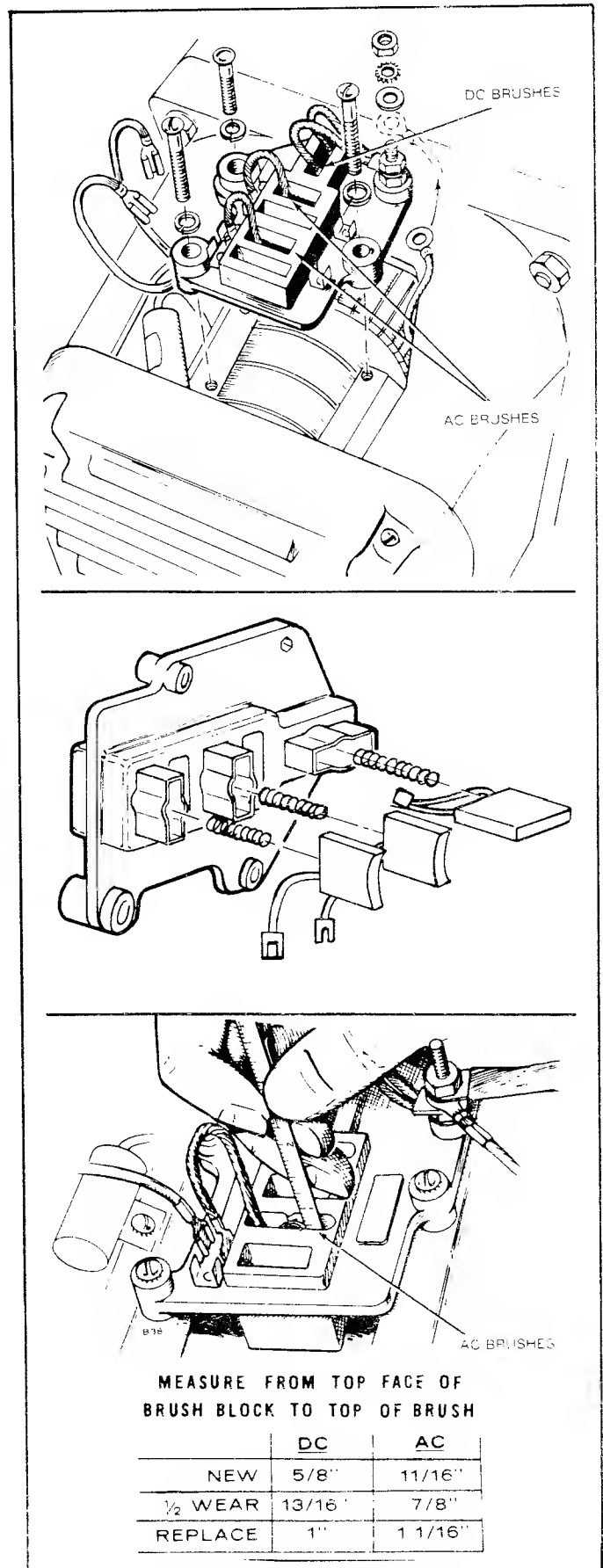


FIGURE 10. BRUSH LENGTH

PERIODIC MAINTENANCE SCHEDULE

Regularly scheduled maintenance is the key to lower operating costs and longer service life for the unit. The following schedule can be used as a guide. However, actual operating conditions under which a unit is run should be the determining factor in establishing a maintenance schedule. When operating in very dusty or dirty conditions, some of the service periods may have to be reduced. Check

the condition of the crankcase oil, the filters, etc. frequently until the proper service time periods can be established.

For any abnormalities in operation, unusual noises from engine or accessories, loss of power, overheating, etc., contact your nearest authorized Onan dealer.

SERVICE THESE ITEMS	AFTER EACH CYCLE OF INDICATED HOURS				
	8	50	100	200	400
General Inspection	X1				
Check Oil Level	X				
Check Battery Electrolyte Level		X			
Change Crankcase Oil			X2		
Check Air Cleaner			X2		
Check Spark Plugs			X4		
Check Breaker Points			X3		
Clean Cooling Fins				X2	
Change Oil Filter				X2	
Replace Breaker Points				X4	
Clean Crankcase Breather				X	
Replace Air Cleaner				X2	
Remove Carbon Deposits from Heads				X	
Adjust Tappets					X
Replace Fuel Filter					X4
Clean Carburetor					X
Check Generator Brushes (Replace if Necessary)	As Required				

X1 - With set running, visually and audibly check exhaust system for leaks.

X2 - Perform more often in extremely dusty conditions.

X3 - Replace if necessary.

X4 - Replace annually or prior to storage.

ADJUSTMENTS

Satisfactory generator set performance relies mostly on correct adjustments. If trouble does develop, follow an orderly procedure to determine the cause before making adjustments. Also refer to *ENGINE TROUBLESHOOTING* and *PERIODIC MAINTENANCE* sections for help.

CARBURETOR

The BF generator set has a carburetor with two fuel mixture adjustments, an idle mixture which affects operation mainly at no load and a main adjustment which affects mixture for maximum load (Figure 11). If your generator set has a "hunting" (sudden surges and drops in speed) condition at no load or full load and cannot be corrected by carburetor adjustments, check governor linkage and adjustment (see *Governor Adjustments*). A hunting condition at no load can often be corrected by an idle fuel adjustment.

CAUTION When determining fuel mixture settings, never force the fuel mixture adjustment needles against their seats (damages the seats and needles).

Main Fuel Adjustment (With Load)

1. Start generator set and allow the engine to warm up for a minimum of 10 minutes.
2. Loosen packing nut (Figure 11) and with main adjustment needle two full turns off its seat, slowly turn in (clockwise) until engine loses speed.
3. Turn main adjustment needle out (counterclockwise) until the engine runs smoothly at full power and speed. Hold this adjustment while packing nut is tightened to be sure it doesn't change.

If the engine develops a slight hunting (sudden surges and drops in speed) condition, open the main needle a little more (not more than 1/2 turn beyond maximum power point).

Idle Fuel Adjustment (No Load)

1. Start the generator set and allow to warm up for a minimum of 10 minutes.
2. Turn out idle adjustment screw (counterclockwise) until the engine loses speed. Note this position.
3. Slowly turn in idle needle (clockwise) past the point where the engine is running smoothly and again loses engine speed. Note this position.
4. Turn out adjustment screw again, only midway between the preceding two positions. The engine should be running smoothly.

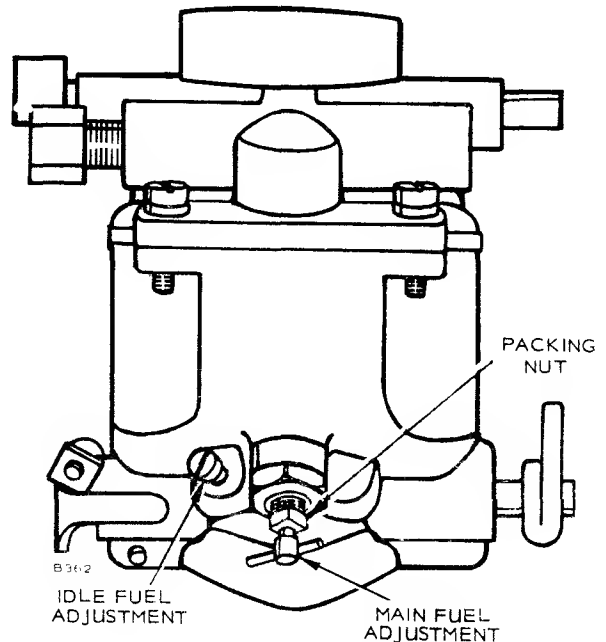


FIGURE 11. CARBURETOR FUEL MIXTURE ADJUSTMENTS

THROTTLE STOP SCREW

The throttle stop screw is located on the throttle shaft lever (base of carburetor near crankcase breather valve). It must be adjusted to obtain 56 hertz at no load with the throttle closed as far as possible (against top of blower housing). See Figure 12.

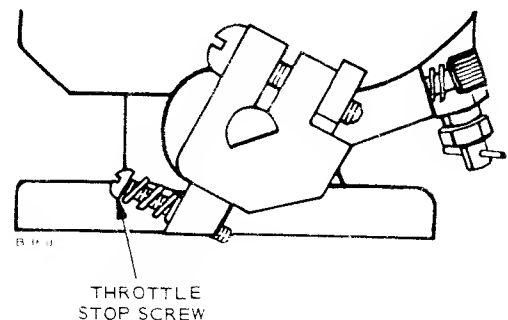


FIGURE 12. THROTTLE STOP SCREW SETTING

Carburetor Float Adjusting

1. Disconnect throttle control, choke cable and fuel line from carburetor.
2. With a screwdriver, remove the three screws on the top of the carburetor and lift off.
3. With the carburetor casting inverted and the float resting lightly against the needle and seat, there should be 1/4-inch clearance (6.35 mm) between the bowl cover gasket and the free end of the float (side opposite needle and seat). See Figure 13.
4. If it is necessary to reset the float level, bend the float near the shaft to obtain the correct level.

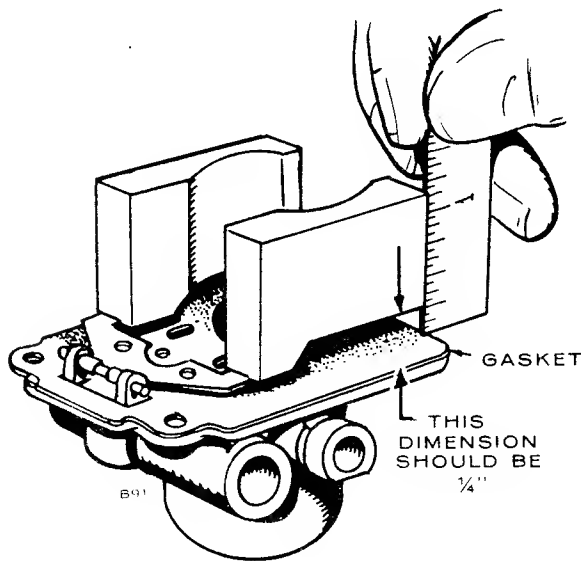


FIGURE 13. CARBURETOR FLOAT SETTING

GOVERNOR ADJUSTMENTS

If carburetor and the following governor adjustments have already been made and the governor action is still erratic, replace the governor spring (Figure 14) with a new one and readjust the governor. Springs lose their calibrated tension through fatigue after long usage.

Before making governor adjustments, run the unit about 15 minutes under light load to reach normal operating temperature. (If governor is completely out of adjustment, make a preliminary adjustment at no load to first attain a safe voltage operating range).

Engine speed determines the output voltage and current frequency of the generator. By increasing the engine speed, generator voltage and frequency are increased, and by decreasing the engine speed, generator voltage and frequency are decreased. An accurate voltmeter or frequency meter (preferably both) should be connected to the generator output in order to correctly adjust the governor. A small speed drop not noticeable without instruments will result in an objectionable voltage drop. The engine speed can be checked with a tachometer.

A binding in the bearings of the governor shaft, in the ball joint, or in the carburetor throttle assembly will cause erratic governor action or alternate increase and decrease in speed (hunting). A lean carburetor adjustment may also cause hunting. Springs of all kinds have a tendency to lose their calibrated tension through fatigue after long usage. If all governor and carburetor adjustments are properly made, and the governor action is still erratic, replacing the spring with a new one and resetting the adjustments will usually correct the trouble.

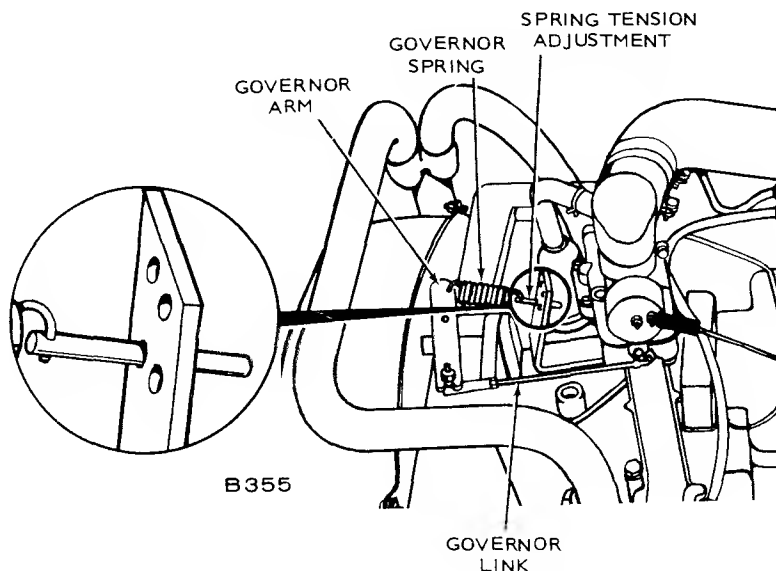
1. Adjust the carburetor idle needle with no load connected.
2. Adjust the carburetor main jet for the best fuel mixture while operating the set with a full rated load connected.
3. Adjust the length of the governor linkage and check linkage and throttle shaft for binding or excessive looseness.
4. Adjust the governor spring tension for rated speed at no load operation.
5. Adjust the governor sensitivity.
6. Recheck the speed adjustment.
7. Set the carburetor throttle stop screw.

Linkage: The engine starts at wide open throttle. The length of the linkage connecting the governor arm to the throttle shaft and lever is adjusted by rotating the ball joint. Adjust this length so that with the engine stopped and tension on the governor spring, the stop on the carburetor throttle lever just contacts the underside of the carburetor bowl. This setting allows immediate control by the governor after starting. It also synchronizes travel of the governor arm and the throttle shaft.

Speed Adjustment: With the warmed-up unit operating at no load, adjust the tension of the governor spring. Refer to the Voltage Chart and the Speed Chart. Turn the speed adjusting nut to obtain a voltage and speed reading within the limits shown.

Sensitivity Adjustment: Refer to the Governor Adjustment illustration, and to the Voltage and Speed Charts. Check the voltage and speed, first with no load connected and again with a full load. Adjust the sensitivity to give the closest regulation (least speed and voltage difference between no load and full load) without causing a hunting condition.

To increase sensitivity (closer regulation), shift the spring toward the governor shaft.



VOLTAGE CHART FOR CHECKING GOVERNOR REGULATION	120 VOLT 1 PHASE 2 WIRE
MAXIMUM NO-LOAD VOLTAGE	132
MINIMUM FULL-LOAD VOLTAGE	108

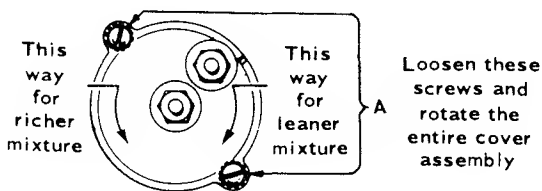
SPEED CHART FOR CHECKING GOVERNOR REGULATION	
MAXIMUM NO-LOAD SPEED (RPM)	1890
HERTZ (CURRENT FREQUENCY)	63
MINIMUM FULL-LOAD SPEED (RPM)	1770
HERTZ	59

FIGURE 14. GOVERNOR ADJUSTMENTS

ELECTRIC CHOKE

If extremes in starting temperatures require a readjustment of the choke, loosen slightly the two cover retaining screws. See Figure 15. For less choking action, turn the cover assembly a few degrees in a clockwise direction. For more choking action, turn counterclockwise. Retighten the cover screws.

If the engine starts and runs roughly after a minute or two of operation, the choke is set too rich. If the engine starts, and assuming that fuel, ignition and compression are adequate, but the engine sputters or stops before it warms up, the choke is set too lean.



AVERAGE CHOKE SETTING	
AMBIENT TEMP (F°)	CHOKE OPENING
58 (14° C)	closed
66 (19° C)	1/4 open
72 (22° C)	1/2 open
76 (24° C)	3/4 open
82 (28° C)	open

FIGURE 15. CHOKE ADJUSTMENT

BREAKER POINTS AND IGNITION TIMING

The correct point gap setting is .021 cold (0.53 mm) and should be adjusted as follows:

1. Remove cover by loosening screw and lift off.

2. To set the point gap turn the engine crankshaft with rotation until the maximum breaker point gap is obtained.
3. Using an allen head wrench, adjust set screw (B) for .021 (0.53 mm). Measure point gap with a flat thickness gauge.

Make sure feeler gauge is clean and free of any grease, oil or dirt. See Figure 16.

The timing is adjusted during initial engine assembly and is fixed by the point gap adjustment. No other adjustment or alignment is necessary. A .021 point gap is equivalent to approximately 21° BTC.

4. Replace point box cover.

The ignition adjustments should be made with the engine in a static condition and cold.

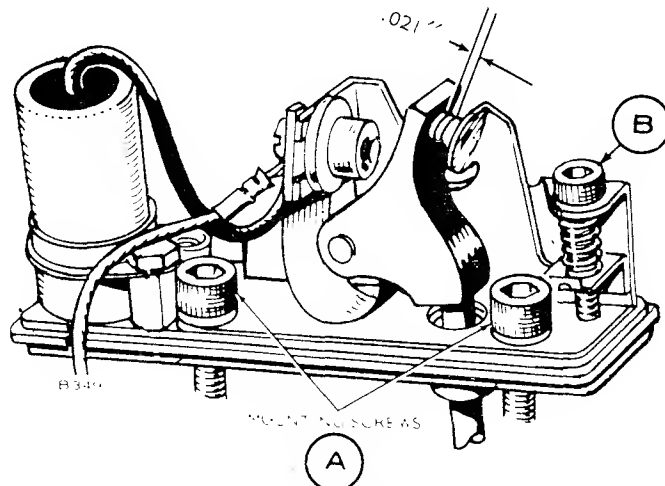


FIGURE 16. TOP ADJUST POINTS

CONTROL TROUBLESHOOTING

ELECTRO-MECHANICAL AND CONTROL TROUBLESHOOTING GUIDE						STEP
CRANKS SLOWLY	CRANKS - NO START	FAILS TO CRANK	RUNS A SHORT TIME	STOPS	PROBABLE CAUSE	
•	•	•			Bad Battery Connection	1
•	•	•			Low Battery	2
	•	•			Faulty Relay K1 or K2	3
•	•				Faulty Fuel Solenoid	4
•	•			•	Faulty Ignition	5
•	•				Faulty Low Oil Pressure Switch	6
		•	•	•	Faulty Choke	7
•	•	•		•	Low Oil Level	8
				•	Governor Out of Adjustment	9

1. Clean and tighten all battery and cable connections.

2. Check specific gravity. Recharge or replace battery if necessary.

3. Push start switch. Check K1-S1 contacts to ground. Battery voltage should appear at this terminal; if not replace solenoid.

Check K2-4 terminal voltage to ground. Battery voltage should appear at this terminal. If not, check for battery voltage at K2 terminals 1 and 2. If battery voltage is there replace K2. If not check the wiring between K1 and K2.

4. Fuel solenoid must open during cranking and running. Check by removing steel line from carburetor and crank engine. If fuel solenoid is open, fuel will pulsate out of this line. If it does not, the fuel solenoid and fuel pump must be checked separately to determine defective part.

WARNING

Use extreme care for this test. Direct fuel flow into a suitable container and make sure area is well ventilated to prevent accumulation of gasoline fumes.

5. Check to see if points open and close during cranking. If they do not open and close, adjust and set points. Plug and plug wires must be in good condition. Voltage at ignition coil negative terminal (-) must alternate from +12 volts to zero volts as points open and close during engine cranking.

6. Remove wire lead from low oil pressure switch. With proper oil level in engine, crank and run engine. Replace wire lead to low oil pressure switch. Engine must continue to run when the wire lead is reconnected. If it does not, replace low oil pressure switch.

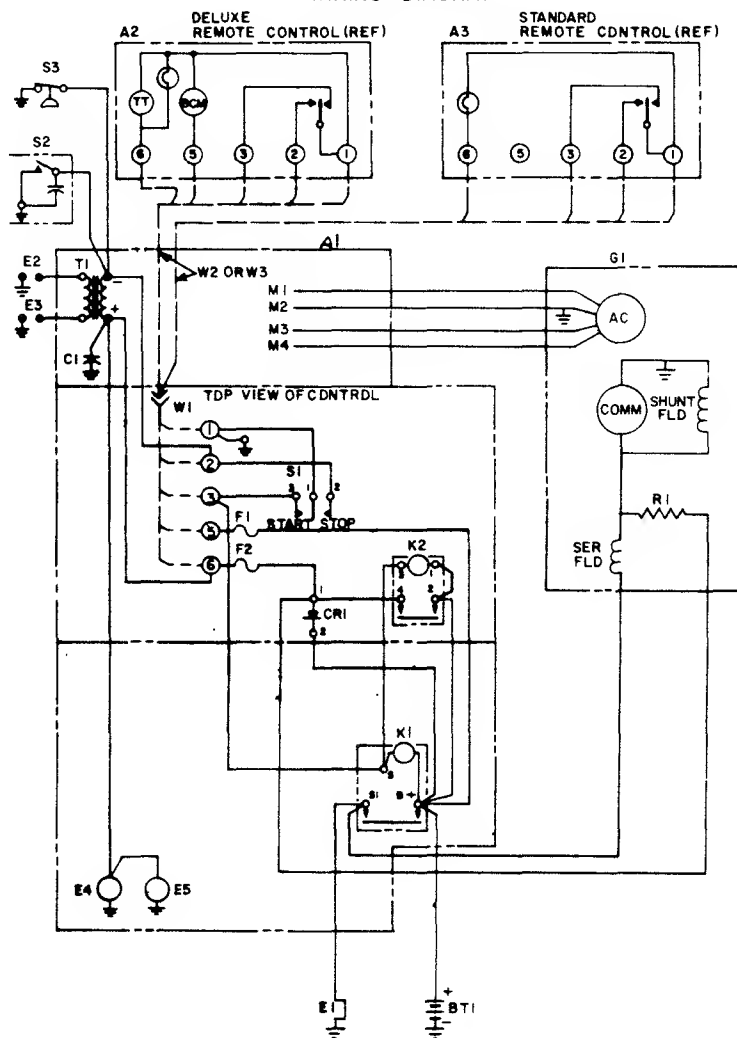
7. With engine not running, check choke vane movement by pushing choke lever arm. Choke must be in closed position with cold engine, and must be free to move against bimetal spring. As engine warms up, bi-metal spring relaxes and allows choke vane to open fully. The lever will pulsate as engine warms up. See *ADJUSTMENT* section.

8. Check oil level. If low or empty, refill to proper level.

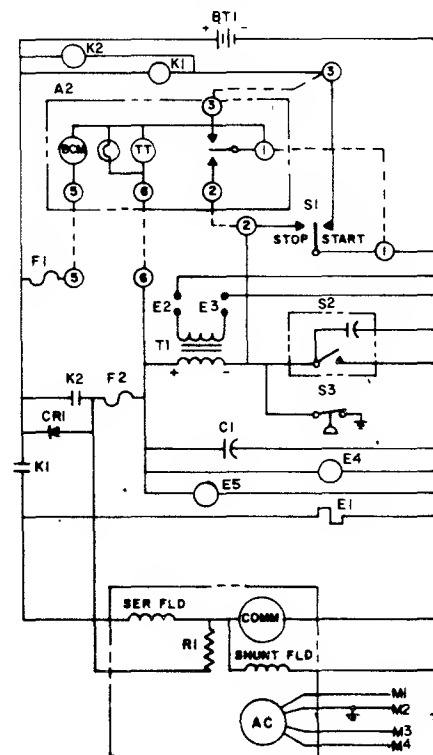
9. Readjust governor.

611-1127

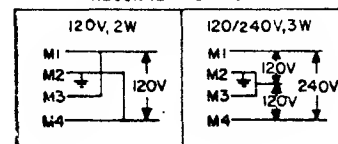
WIRING DIAGRAM



SCHEMATIC



RECONNECTION CHART



- A1 Control Assembly
- S1 Start-Stop switch
- F1, F2 Fuse (9-amp, 32 volt)
- K1 Start Solenoid
- S2 Breaker Points Assy.
- S3 Low oil pressure switch
- E1 Onan choke
- E5 Fuel Solenoid
- E4 Electric fuel pump
- T1 Ignition coil
- K2 Crank Ignition Relay

- G1 Generator
- R1 Battery charging resistor (fixed value)
- BT1 12 volt battery
- E2, E3 Spark Plugs
- CR1 Reverse current diode (prevents battery discharge when unit is shut down)
- A2 Deluxe remote control
- A3 Standard remote control

REMOTE ACCESSORIES

INSTALLING STANDARD REMOTE CONTROL

This control includes a start-stop switch with an indicator lamp. Install as follows:

1. Select switch location. Using Figure 17 as a guide, drill screw holes and cut holes in RV panel.
2. Following national and local electrical codes and using four insulated wires of predetermined length (#18 or larger), connect remote switch to terminals on generator. See Figure 18.

CAUTION Ensure that leads from remote switch connect with corresponding terminals on generator terminal board.

CAUTION Don't route DC wires for remote control through conduit containing AC load wiring. Induced voltages may cause erratic operation.

3. Insert remote switch in hole cutout and secure with two #5 woodscrews supplied with switch.

WARNING

Seal all holes that might allow noxious gases from generator set into motor home.

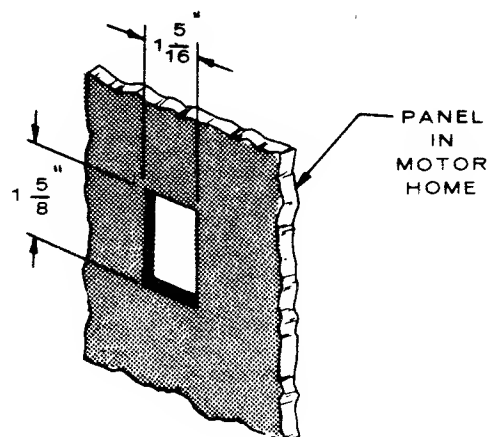


FIGURE 17. MOTOR HOME CUTOUT

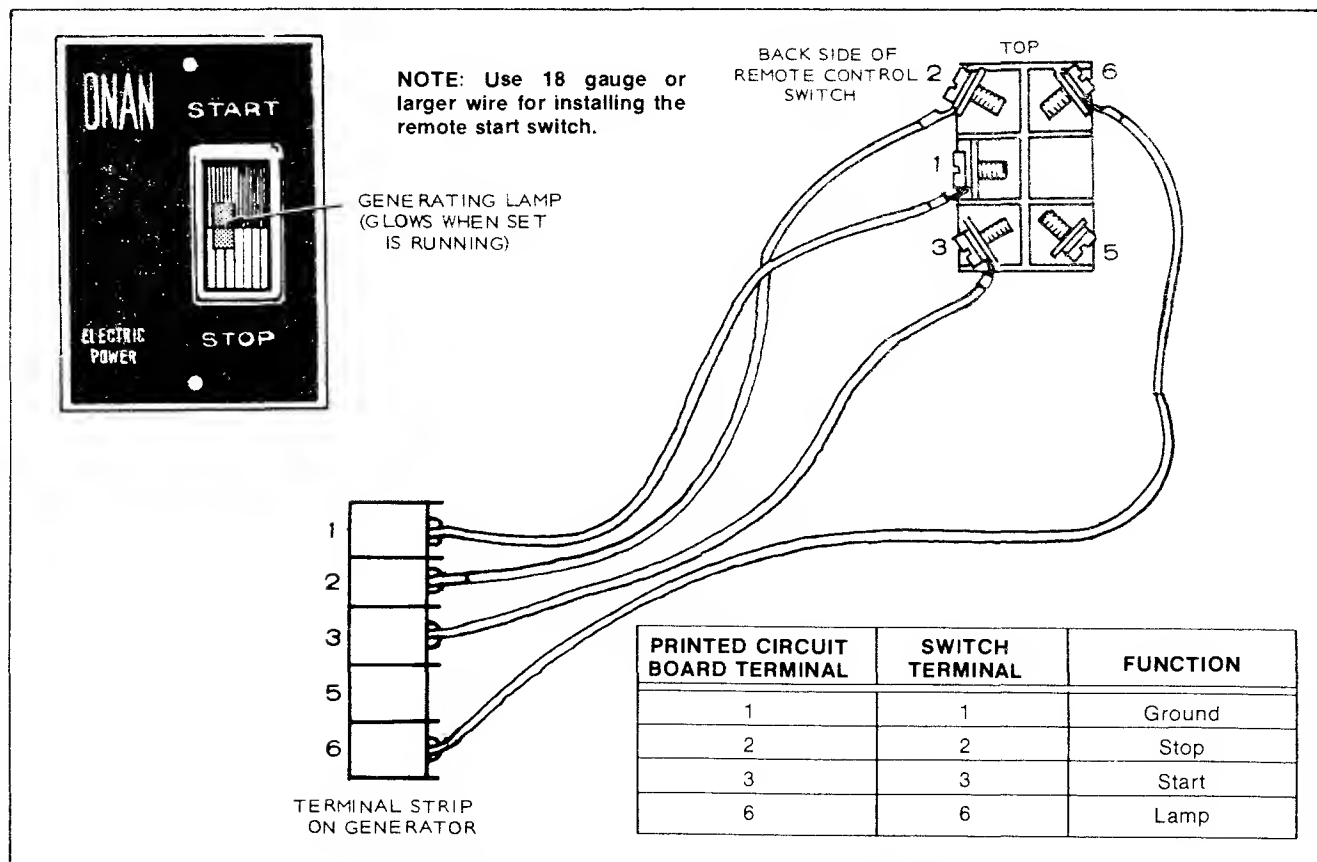


FIGURE 18. CONNECTING REMOTE CONTROL (300-0985)

INSTALLING DELUXE REMOTE CONTROL

This control includes a start-stop switch with an indicator lamp, a running time meter and a battery condition meter. Install and connect as follows:

1. Select control location. Using Figure 19 as a guide, drill screw holes and cut hole to accommodate remote switch in panel.
2. Following national and local electrical codes and using five insulated wires of predetermined length (#18 or larger), connect remote control to terminals on generator. Ensure that leads from remote control connect to corresponding terminals on generator terminal board. See Figure 20.

CAUTION Don't route DC wires for remote control through conduit containing AC load wiring.

3. Insert remote control in hole cutout and secure with four #5 woodscrews supplied with switch.

WARNING To prevent noxious gases from entering vehicle interior, seal any openings made in the set's compartment for conduit, wiring, etc.

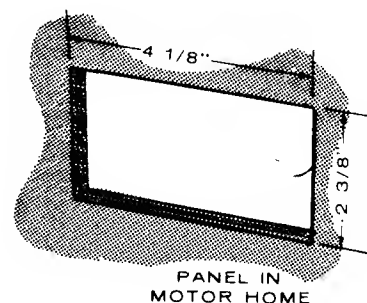


FIGURE 19. MOTOR HOME CUTOUT

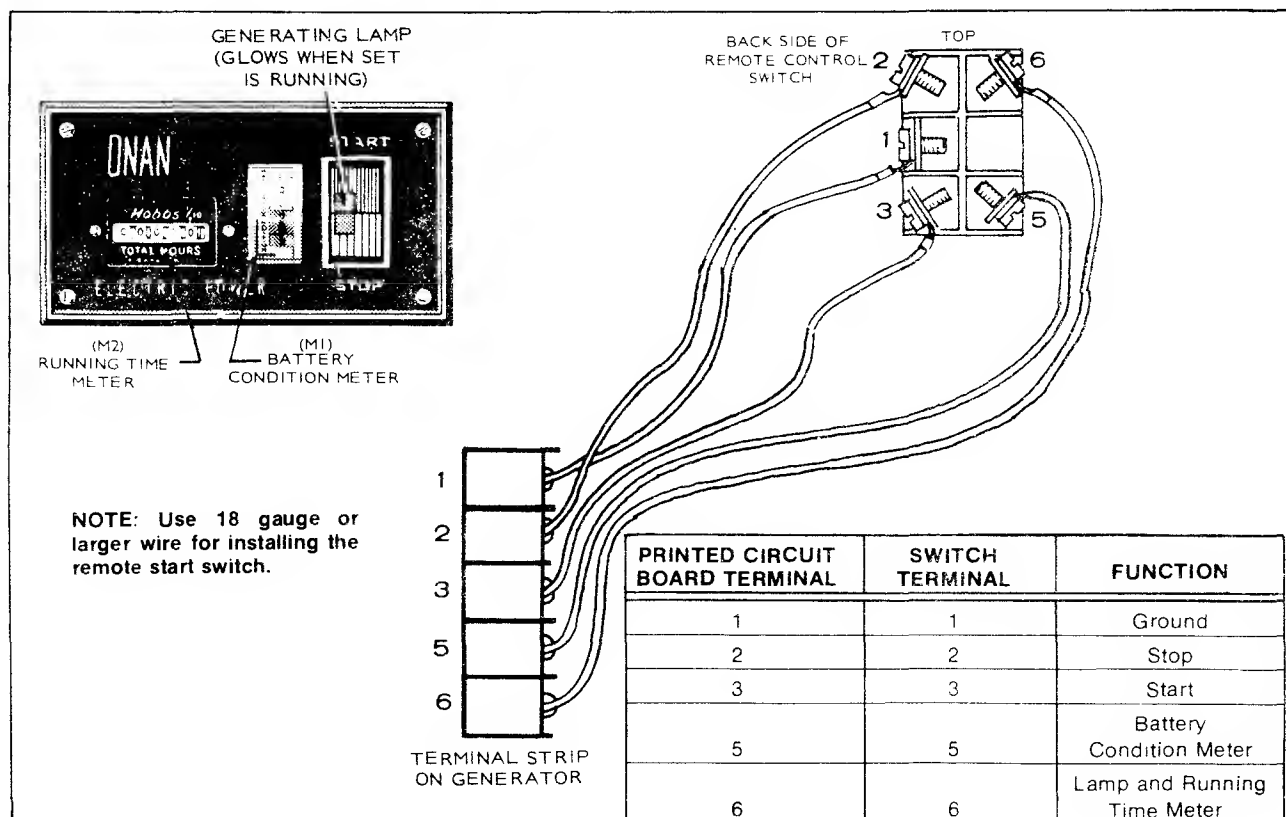


FIGURE 20. CONNECTING DELUXE REMOTE CONTROL (300-0985)

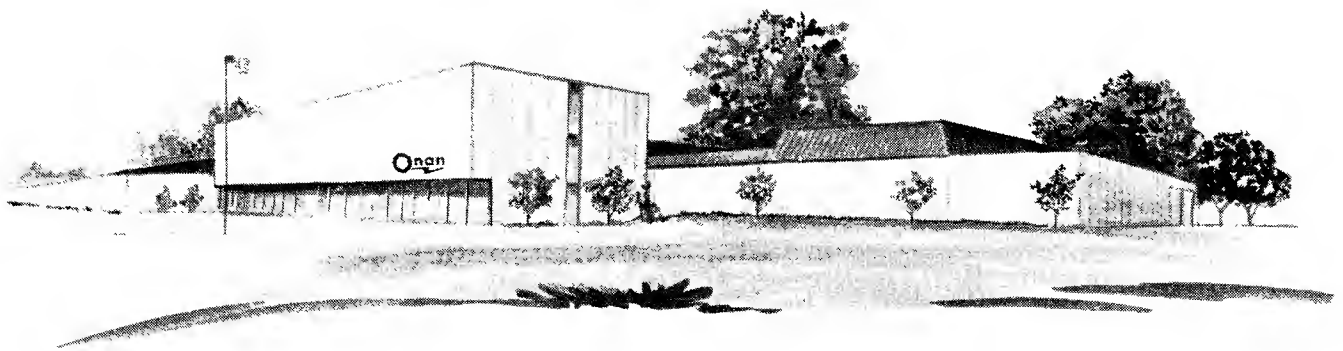
PARTS INFORMATION

The following Running Replacement parts list consists of external items which may require replacement due to normal wear and service and can usually be installed by the operator.

For additional information on parts or service contact your nearest authorized Onan dealer or Service center. A complete parts catalog is available and may be ordered under #965-0220.

RUNNING REPLACEMENT PARTS LIST

Part No.	Description
140-0495	Air Cleaner Element
167-0241	Spark Plug
160-1183	Breaker Points
312-0196	Condensor (Breaker Points)
166-0643	Coil, Ignition
142-0362	Carburetor
142-0033	Carburetor Gasket Kit
149-1304	Fuel Pump Electric (Onan)
214-0095 (DC)	Generator Brushes
214-0096 (AC)	Generator Brushes
307-0845	Start Solenoid
307-1457	Fuel Solenoid
168-0123	Carbon Removal Gasket Kit
154-1725	Exhaust Manifold Gasket
321-0194 (2 each)	Fuses for Control
402-0284	Vibration Isolators



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